Electronics and Electrical Communications Department

Tanta University | Faculty of Engineering

Course: Digital Communication Systems	Course Code: EEC 3220	Year: 3rd
Date: 14/2/2015	Allowed Time: 2 Hours	No. of Pages: (2)

Sheet (1): Sampling Theorem

Problem 1

a. Sketch the following signal:

$$s(t) = \sum_{n=-3}^{+5} \delta(t - nT_s)$$

b. Obtain and sketch the Fourier transform for the impulse train given above assuming that n extends to infinity ($-\infty \leq n \leq \infty$).

Problem 2

Obtain and sketch the Fourier transform for the pulse train shown in Fig.1 given that the pulses amplitude and duration are 1 and τ respectively.

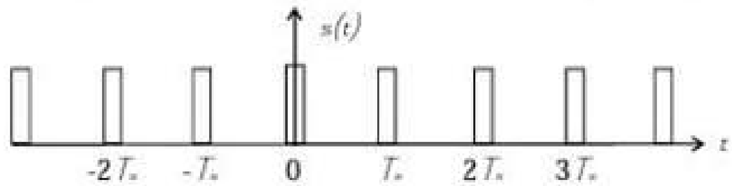

Fig.1

Problem 3

a. Assume that the analogue signal shown in Fig.2 was sampled by multiplying it by an impulse train. Draw the frequency domain of the digital signal when the sampling rate is 25% greater than the Nyquist criteria.

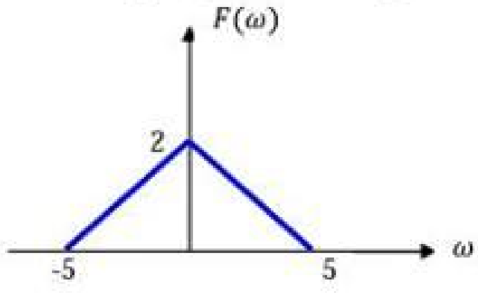

Fig.2

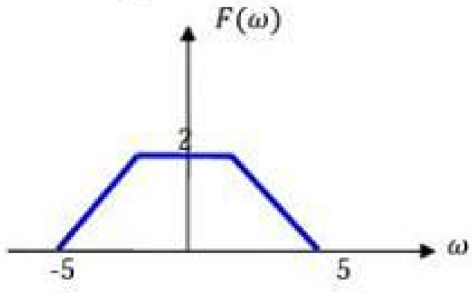

Fig.3

b. Repeat the above question for the signal shown in Fig.3 when the sampling rate is 10% less than the Nyquist rate.

Problem 4

Assume the case of instantaneous sampling. Calculate the guard frequency band between various components of the sampled signal at the following cases:

a. The analogue signal bandwidth is 10 kHz while the sampling rate is 20% greater than the Nyquist rate.

b. The analogue signal bandwidth is 8 kHz while the sampling rate is 40% greater than the Nyquist rate.

c. The analogue signal bandwidth is 4 kHz while the sampling rate equals the Nyquist rate.

d. The analogue signal bandwidth is 15 kHz while the sampling rate is 20% less than the Nyquist rate.

e. Comment on the above four cases.

Problem 5

The frequency of the aliased signal f_a can be found from the following equation:

$$f_a = |f_s * n - f_m|$$

Estimate the aliasing frequency for the case where:

- f_m (the frequency of the signal being sampled) = 70MHz
- f_s (sampling frequency) = 100 M Samples/s
- n Closest integer multiple of the sampling rate to the signal being aliased.

Then draw the frequency amplitude plot of aliased signal, f_a, occurs due to "aliasing back" from original signal of 70 MHz.